A study of the sustainability of 
ICT-projects in developing countries

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Abstract
Title: A study of the sustainability of ICT projects in developing countries.

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Background: Information and Communications Technology (ICT) is believed to contribute to the socio-economic growth of developing countries. However, many ICT-related development projects in developing countries are short-lived, i.e., they fail to sustain.

Purpose: The purpose of this thesis is to study what factors influence the sustainability of ICT-projects in developing countries.

Method: The study is based on a systematic review of existing literature on the subject, and data from interviews and observations. A case study of an ICT-project in southern India is performed. All data is of qualitative type.

Conclusions: A set of 14 factors that influences the sustainability is identified. The factors are related to the various resources and stakeholders involved in a project.

Keywords: Sustainability, ICT, Evaluation, Sustainable, Aid, Pilot project.
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Carl Gunnstam & Carl Johan Nordquist
# Table of Contents

ABSTRACT .................................................................................................................. III  
ACKNOWLEDGEMENT ............................................................................................... IV  
TABLE OF CONTENTS ............................................................................................... V  

1 INTRODUCTION ..................................................................................................... 1  
1.1 Introduction and Formulation of Research Questions ........................................ 1  
1.2 Document Outline ............................................................................................... 2  

2 BACKGROUND ..................................................................................................... 4  
2.1 The Concept of Sustainability ........................................................................... 4  
2.1.1 Definitions of Sustainability ........................................................................ 4  
2.1.2 Why be concerned about sustainability? ....................................................... 4  
2.2 Sustainability as Research Subject ..................................................................... 5  
2.3 Information and Communication Technologies .............................................. 7  
2.3.1 Definition of ICT ......................................................................................... 8  
2.3.2 ICT for Development .................................................................................. 8  
2.3.3 An ICT for Development Hype .................................................................. 9  
2.4 Ericsson Communications Expander ............................................................... 11  

3 METHODOLOGY .................................................................................................. 13  
3.1 Working Process ............................................................................................... 13  
3.2 Methodological perspective ............................................................................. 14  
3.2.1 Systematic Literature Review – Method .................................................... 15  
3.2.2 Application of the Framework .................................................................. 17  

4 THEORETICAL FRAMEWORK ............................................................................. 19  
4.1 The Innovation Decision Process .................................................................... 19  
4.2 Innovations and Behavioral Change .................................................................. 19  
4.3 Stakeholder Mapping ....................................................................................... 21  

5 SYSTEMATIC LITERATURE REVIEW .................................................................. 22  
5.1 Results of the Systematic Literature Review .................................................. 22  
5.2 Success Factors for Creating Sustainable Projects ........................................ 22  
5.2.1 Economic Viability .................................................................................... 22  
5.2.2 Economic Resilience .................................................................................. 23  
5.2.3 Human Resources ...................................................................................... 23
1 Introduction

1.1 Introduction and Formulation of Research Questions

The spreading of Information and Communication Technology (ICT) in developing countries is believed to contribute to the socio-economic growth of such countries. However, many ICT-related projects in developing countries fail to sustain and end prematurely. While not all projects should endure indefinitely, there are good reasons for trying to create sustainable projects. The sustainability of ICT-projects in developing countries is therefore a subject of great interest, in particular since large resources are being invested in such projects around the world.

Ericsson AB, together with Apollo Hospitals Group, is conducting an ICT-related health project in Tamil Nadu, India, with the purpose of providing healthcare to the rural parts of India. This thesis originates from Ericsson’s wish to evaluate the project’s ability to sustain in a long-term perspective. To make this question feasible for a master thesis, a generalized problem was formulated, namely what factors influences the sustainability of ICT-projects in developing countries? The knowledge acquired by studying this general question was subsequently applied to Ericsson’s specific project in Tamil Nadu.

In this study, a systematic literature review was performed to gather the current research on the sustainability of projects. Although the subject is young, research has been performed trying to explain the determinants of sustainability of projects. Therefore, an important part of the thesis was to establish the current state of knowledge, and construct a framework that made it possible to employ current research results in actual projects. This framework could then be applied to Ericsson’s project in Tamil Nadu, India, to judge its ability to sustain.
Three research questions were formulated for the study. The main question was:

- What factors affect the sustainability of Information and Communications Technology (ICT) projects in developing countries?

In order to answer this question, two sub-questions were formulated:

- What does current research say about sustainability of projects?
- How can the current state of research be concluded in a framework that allows employing the research results in actual projects?

In this thesis, when referring to ICT-projects, we are referring to development projects that utilize ICT, as opposed to e.g. research & development of ICT that happens to take place in developing countries.

1.2 Document Outline

This document is structured as below.

Chapter 1 – Introduction & Question Formulation
The introduction and formulation of research question provide a brief background of the ideas behind this thesis. The research problem is specified and broken down into sub-questions that will be answered by this thesis.

Chapter 2 – Background
The second chapter explains the central themes that are used throughout this thesis. It helps to build an understanding of the concept of sustainability, ICT and how they relate to each other.

Chapter 3 – Methodology
The third chapter describes the chosen research methods and the overall methodological perspective.

Chapter 4 – Theoretical Framework
This chapter related theories to the reader.

Chapter 5 – Systematic Literature Review
The systematic literature review is conducted. This chapter presents both the results of the review, and the analysis of its findings. The project sustainability framework is constructed.

Chapter 6 – Case Study: The Gandhigram Project
The Gandhigram project and related concepts are presented. The project sustainability framework is applied to the project and the results are presented and analyzed. Insights about the framework from the application are discussed.

Chapter 7 – Conclusions
The final chapter draws general conclusions from the analysis and proposes areas for further research.
2 Background

This chapter presents some of the central themes discussed in the thesis, such as sustainability and ICT.

2.1 The Concept of Sustainability

2.1.1 Definitions of Sustainability

In 1987 a United Nations report stated that “sustainable development (...) should become a central guiding principle of the United Nations, Governments and private institutions, organizations and enterprises” (UN, 1987). Since then, the terms sustainable development and the broader sustainability has gained great popularity although a common understanding of what the terms exactly denote have been missing. In a study 2000, over 300 definitions of sustainability were found (Sustainability Now, 2000). The terms are often used in regards to environmental issues. However, this thesis considers sustainability as a broader concept. In this thesis, when discussing the sustainability of projects, we refer to the ability of a project to endure over time. In order for a project to be sustainable, it must be sustainable in regards to the environment, its economic conditions, and so forth. In conclusion, this thesis will use the term sustainability in the same manner as the Swedish international development cooperation agency (SIDA): ”When we discuss sustainability we are concerned with the likelihood that the benefits from a project will be maintained for a reasonably long period of time” (SIDA, 2007).

2.1.2 Why be concerned about sustainability?

Why should we be concerned about the sustainability of development projects? Clearly, there are situations when a project should not sustain and the termination of a project is appropriate. For instance, a project might be intended to assist during a temporary problem. However, this thesis considers projects that end prematurely; projects in which the termination is
considered a failure. In these projects, there are plenty of reasons why one should be concerned about sustainability. The University of Manchester project "eGovernment for Development Information Exchange" recognized six potential costs of failing projects (eGovernment for Development, 2008). While these were developed specifically for eGovernment projects, the authors believe they apply to ICT projects in general.

The six potential costs of unsustainable projects are:

- **Direct financial costs**: loss of money invested in equipment, facilities, training programs etc.
- **Indirect financial costs**: loss of money invested in the time and effort of public servants involved.
- **Opportunity costs**: money and time that could have been used on other projects if it was not spent on the failing project.
- **Political costs**: loss of credibility and image for the individuals and organizations involved.
- **Beneficiary costs**: loss of the benefits that a successful project would have brought.
- **Future costs**: a failing project may increase the barriers for future projects because of the bad track record that may extend risk aversion among stakeholders.

To conclude, projects that fail to sustain bring direct and indirect costs, damages credibility and trust, and prevents the intended benefits of being delivered.

### 2.2 Sustainability as Research Subject

As a research subject, sustainability of projects is young and crosses several areas. Large contributions have been made by international organizations such as United Nations and the World Bank, and governmental donor
organizations, e.g. SIDA in Sweden. Naturally, these organizations have great incentives to ensure that the projects they are involved in are successful and the results are sustained over time.

History has proven it hard to successfully carry out sustainable development projects. In 1997, Stockmann investigated the sustainability of certain types of development projects and concluded that only three out of ten projects studied were able, in overall terms, to achieve a high degree of sustainability (Stockmann, 1997). The following year noted Shediac-Rizkallah et. al. (1998) that "an empirical knowledge base about the determinants of sustainability is still at an early stage". Since then, the concept of sustainability has gained more attention and research, but the results are yet bleak. University of Manchester’s initiative for eGovernment project estimates that approximately 35% of all eGovernment projects fail completely, ~50% partially fails and the remaining ~15% are successful (eGovernment for Development, 2008). In a 2007 paper, Surana et. al. conclude that "in practice creating sustainable ICT projects is extremely difficult".

The systematic literature review presented in chapter 5 provides a thorough background the research on project sustainability. But what is actually a successful project? A development project often involves numerous stakeholders with, in some cases, different objectives. Deeming a project successful or unsuccessful is therefore not trivial. The different possible outcomes of a project can be outlined as follows:

<table>
<thead>
<tr>
<th>Success</th>
<th>Partial failure</th>
<th>Total failure</th>
</tr>
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Figure 1: Different project outcomes. Adapted from Heeks (2002).

Total failure – a project that is never implemented or implemented but abandoned immediately after its launch. This outcome can be defined quite objectively. Example: After over a year of analysis and planning, the project
Indira Gandhi Conservation Monitoring Centre, India, collapsed shortly after its launch (Heeks, 2002). It can hence be regarded as total failure.

Partial failure – a project where major goals are not attained, or there are major undesired outcomes. It is possible that the objectives of some stakeholders are achieved, implying that these stakeholders may deem the project successful, while others would disagree. This outcome is more subjective to define. A project that is initially successful but fail to sustain can be placed in this category. For example, the creation of touch-screen information kiosks in South Africa, 2000, was initially very successful and well received by the communities. However, less than a year later the kiosks were removed, due to lack of updated or local content. (Benjamin, 2001).

Success – a project where most stakeholders attain their major goals and there are no major undesired outcomes. This outcome is easier to objectively define. Example: In the 1999 elections, an ICT project supporting South Africa’s Independent Electoral Commission helped 18 million voters to be registered at 15,000 voting stations. The voting was a success according to all stakeholders and the commission subsequently received ComputerWorld’s Smithsonian Award 2000 (IEC, 2000).

With these possible outcomes of a project in mind, we can conclude that a sustainable project is not necessarily a success, but an unsustainable project is definitive a failure. We can hence state that sustainability is a necessary, but not sufficient, criteria for the success of a project.

2.3 Information and Communication Technologies

This thesis recurrently discusses Information and Communication Technologies (ICT) and its role in development. Below follows a short introduction of the subject.
2.3.1 Definition of ICT

ICT is a generic term for all information and communication technologies. It can broadly be defined as "electronic means of capturing, processing, storing, and communicating information" (Heeks, 1999). The term ICT is often used interchangeably with IT, but ICT explicitly highlights that communications technologies are included such as mobile communication and telephone landlines.

2.3.2 ICT for Development

During the 20th and 21st centuries, the development of ICT has exploded. However, the benefits of ICT have mainly reached the developed parts of the world. In developing countries access to ICT is still limited. This divide between those with access to ICT and those without has been coined the digital divide and received attention during the last decade. One of the reasons of the attention is that research indicates that the presence of ICT stimulates development and the economic growth of states.

In a well-noticed study in 2005, Prof. L. Waverman of the London Business School found that an extra 10 mobile phones per 100 people in a typical developing country leads to an 0.59% increase in GDP growth per person. The study was recently repeated with similar results (Waverman et. al., 2005). A hands-on example of how ICT can stimulate economic growth is provided by the story of fishermen in Kerala, India, who increased their profits and at the same time lowered the consumer prices of fish, after the introduction of mobile phones (Jensen, 2007). The following quote explains the problem the fishermen were facing daily:

"You are a fisherman off the coast of northern Kerala, a region in the south of India. Visiting your usual fishing ground, you bring in an unusually good catch of sardines. That means other fishermen in the area will probably have done well too, so there will be plenty of supply at the local beach market: prices will be low, and you may not even be able to sell your catch. Should you head for the usual market anyway, or should you go down the coast in the hope that fishermen in that area will not have done so well and your fish
will fetch a better price? If you make the wrong choice you cannot visit another market because fuel is costly and each market is open for only a couple of hours before dawn—and it takes that long for your boat to putter from one to the next. Since fish are perishable, any that cannot be sold will have to be dumped into the sea.”

Mobile phones and economic growth, The Economist, May 2007

When the fishermen could use mobile phones, they could call the different local markets to find out where the demand was high on that particular day. Fishermen started to travel beyond their home market to sell their catch. As a result, a more efficient market was established in the community. On average, the fishermen increased their profits by 8% and the consumer prices lowered by 4% (Jensen, 2007).

Now consider what would have happened if the fishermen, for instance, would not be able recharge their mobile phones due to lack of electric power in the area, or if the phone calls were attached with a costs the fishermen could not bear. Undoubtedly, the fishermen would stop using their phones and the positive outcomes would not have taken place. This illustrates the challenges that ICT projects can face to sustain.

2.3.3 An ICT for Development Hype

As the world went through a phase of ICT-hype around the break of year 2000, the concept of ICT for development also got its share of the hype. Below is a short introduction of this subject, as it has influenced the current view of ICT’s role in development.

“Governments, donors and development organisations are rushing to realise the benefits that Internet access promises in the fight against poverty” wrote a researcher in 1998 (Panos, 1998). The belief that ICT could stimulate development was occasionally distorted into a belief that ICT, quite automatically, would bring development. ICT was turned to a goal itself. A critical paper stated that this belief was “driven on hype from ICT vendors and the media” and that it is “turning use of ICTs within
development into an end in itself rather than a means of achieving other development goals” (Heeks, 1999).

**Different Views About ICTs and Their Impacts**

![Diagram showing different views about the impact of ICT.](image)

Figure 1: Different views about the impact of ICT. Adopted from Heeks, 1999.

To illustrate the different views on ICT and its impact on development, we can use the framework above. During the hype, the view of the impact of ICT was shifted towards position A; the belief was that the impact of new technology would be positive, and that the technology itself was the cause of the impact.
However, this view has gradually shifted towards position B. Today there is a common understanding that ICT can have positive impact but it is people, not the technology itself that determine the impact. Bill Gates, chairman of Microsoft and founder of one of the world’s largest private donor foundations, Bill & Melinda Gates Foundation, admitted that he was “naive, very naive” when he began donating in 1994, expecting that computers and information technology would make up the most of his donations.

“Computers are amazing in what they can do, but they have to be put into the perspective of human values (...). The world's poorest two billion people desperately need healthcare, not laptops. (...) Mothers are going to walk right up to that computer and say, "My children are dying, what can you do?" They're not going to sit there and, like, browse eBay or something.”

To conclude this section, the following quote summarizes the role of ICT in development today: “groups as diverse as the UN, NGOs, governments, the World Bank and multinational corporations have provided financial and policy support to ‘bridge the digital divide’ in developing countries. (...) Even though their goals may be different, these various actors have converged on the idea that ICTs can support socio-economic development” (Kuriyan et. al., 2006).

2.4 Ericsson Communications Expander

This thesis has been conducted with support from Ericsson Communications Expander. Ericsson Communications Expander is a marketing program within Ericsson AB created in 2007. It aims to provide knowledge and technology to meet the needs of a growing number of telecommunication users from lower income segments of rural and urban areas (Ericsson AB, 2007).

In late December 2008, it was estimated that there are four billion mobile subscribers globally (3G Americas, 2008). But so far, the expansion of mobile communication has primarily reached developed countries and
higher income segments of the developing countries. In the next five years, the number of mobile subscribers globally is expected to reach 6.5 billion, primarily by the expansion of mobile communication to lower income segments in developing countries where daily income is around a few US dollar (Ericsson AB, 2007:2). This implies a shift in the competitive environment for mobile operators, moving from middle- and high- to low-income segments. Ericsson Communications Expander aims to provide knowledge and technical solutions to the mobile operators in this transition.
3 Methodology

3.1 Working Process

The working process of this thesis can be illustrated as below:

![Working Process Diagram]

Figur 1: Working process.

As stated in the introduction, this thesis is based on an assignment from Ericsson AB. Therefore, the first step was to understand the assignment from Ericsson’s point of view and generalize this into a problem suitable for an academic thesis study. This involved formulating the research questions presented in the first chapter and agreeing on the outcomes and important dates for the thesis. Meetings with the tutors from both Ericsson AB and Lund University ensured that everyone agreed on the task.

The second step involved choosing the methods to investigate the problem that were specified in the first step.

The third step was to find theories and previous research on the subject. This was a major part of the thesis since a systematic literature review was conducted to create a comprehensive picture of the current state of research on project sustainability. Furthermore, theories on the adoption of innovations and organizational change were investigated to determine if they could support in solving the research problem.

The fourth step was to employ the material found in the third step to build a framework of relevant factors that impact on the sustainability of projects. This model, consisting of findings of previous research on the sustainability
of projects, was constructed to create a “current state of knowledge” and to make the research findings on sustainability accessible to ourselves and other practitioners.

The fifth step was to apply the framework constructed in the forth step on Ericsson AB’s project in Tamil Nadu, India. This involved identifying people with insight into the project and formulating questions to cover the different aspects of the framework. This application also served as a first preliminary validation of the framework.

The sixth step of the working process was to revise the framework based on the knowledge acquired by trying to apply the framework on the Ericsson project.

The seventh and final step was to draw conclusion from the study. This step included two parts: first, to draw conclusions and make recommendations to Ericsson for the specific project studied in Tamil Nadu. Second, to draw general conclusions from the research and show where this study fits in the research field as a whole.

3.2 Methodological perspective

Given a time constraint of 20 weeks, how does one study and draw conclusions on the sustainability of a project that will run far longer than the given time limit? Conducting thousands of randomized experiments in a laboratory is simply not possible in this area of research. The answer was to build on the findings of previous research. By collecting the current research (through a systematic literature review) and construct out of this a framework on project sustainability (a “current state of knowledge”), the necessary tools were created.

The methodological perspective of this study can be described as an exploratory investigation on what makes ICT projects in developing countries sustainable. The design of the investigation has been flexible,
meaning that questions and focus shifted based on findings along the way. The study is neither strictly deductive as the systematic approach would suggest, nor strictly inductive. The study is better characterized as an iterative process between the inductive and deductive approaches with openness to unforeseen information along the way.

The primary source of information has been a systematic literature review. The quality of literature reviews are in general affected by the availability of relevant documents and if the selected documents are reliable (Jacobsen, 2002). In this case, the availability of relevant documents was good. Three types of documents were included in the literature review. The first type was journal papers, i.e. documents published by scholars in international journals. These papers are peer-reviewed before published which improve their reliability. The second type of document is organization guidelines, i.e. documents published by international organizations, such as the United Nations, World Bank, and national donor agencies, e.g. SIDA in Sweden, containing guidelines for its personnel when conducting projects. While these are formally not research papers, they are the results of the great experience these organizations possess within the subject. With many years of work with projects in developing countries, these organizations have immense experience of the subject and incentives to create sustainable projects. Hence, the reliability of these documents is also believed to be good. The third category is working papers, i.e. working papers presenting findings of research that are considered “work in progress”. These are not published and hence not peer-reviewed. In the literature review, these papers were not included in the final selection of papers.

3.2.1 Systematic Literature Review – Method

The systematic literature review was conducted in order to locate previous research regarding the primary research question of this thesis: what factors affect the sustainability of ICT-projects in developing countries? However, in the literature search all types of development projects were included, i.e. not only ICT-projects. In order to find relevant studies the major scholar
databases Proquest, Elsevier, Wiley, Springer, informaworld and IEEE were searched through Lund University’s electronic library tool ELIN. After some preliminary searches, the following keywords were selected:

- Sustainability
- ICT
- Evaluation
- Sustainable
- Aid
- Pilot

These keywords were used for constructing search criteria. All databases were searched for studies containing any combination the keywords, for example:

- Sustainability AND Pilot
- Sustainability AND Evaluation
- Aid AND Sustainable
... 

The time of publishing was limited to the last ten years, i.e. only studies published between 1999-2008 was considered. No other exclusion criteria were employed. In addition to this, the websites of international donor organizations such as World Bank, UNDP, SIDA, USAID etc. was searched for studies regarding their projects. Finally, a free text web search (using the keywords above, but searching in free text as opposed to only in keywords) was performed using Google.

The literature search resulted in a large set of papers that fitted the inclusion criteria and could be selected for further screening. The screening process consisted of reading the abstracts, and in some cases further parts of the study to determine whether the study was relevant or not. After this screening process, the final set of papers consisted of 18 papers, which were all relevant to the research question of what makes ICT-projects in
developing countries sustainable. The final set of papers is presented in appendix A.

### 3.2.2 Application of the Framework

The findings of the systematic literature review were used to construct a current “state of knowledge” in the form of a framework for project sustainability. The framework could then be applied to Ericsson’s project in Tamil Nadu, India. The primary source of information when applying the framework was *in-depth interviews* with key persons from the project. The interviews consisted primarily of open questions, based on the different aspects of the framework. The interviews were all except one conducted face to face with the respondent, since telephone interviews are less suitable for this type of interviews (Jacobsen, 2002). The interviews were recorded using a laptop computer, which has allowed the authors to quote the respondents correctly when needed. This also enables the interviewers to concentrate on the questions instead of taking notes during the interview. None of the respondents said nor seemed to be uncomfortable with the fact that the interview was recorded.

There are mainly two things that can affect the interviews: the *interview effect* and the *contextual effect*. The interview effect is the effect the interviewer has on the respondent. There is a risk that the respondent is affected by the presence of the interviewer and acts and answers in a manner he/she would not have done elsewhere. During the interviews in this study, all the respondents seemed comfortable and relaxed. The authors therefore believe that the interview effect has had very little effect on the outcome of the interviews.

The contextual effect denotes that people tend to act differently based on the context they are currently in. This mean that it is desirable to conduct interviews in a place where the respondent feels at home, so that the context effect has a small impact on the respondent’s answers. In this study, all interviews were conducted with the respondents at their own offices. Thereby, the context effect should have little impact on the given answers.
The data from both the interviews and the literature review is \textit{qualitative}. A qualitative study can collect its data from different sources, of which the four most common forms are individual interviews, group interviews, observations and literature reviews (Jacobsen 2002). A study should ideally use more than one form, since this brings the study closer to a detailed and comprehensive picture. In this thesis, all forms except group interviews have been used.
4 Theoretical framework

4.1 The Innovation Decision Process

One approach to sustainability is to view it as the “institutionalization” of a project and the project’s outcomes. As a community adopts the new processes a project provides, the project eventually loses its separate identity and become part of the daily life. This process is referred to as the “institutionalization”. Using this perspective, theories of the adoption of innovations are valuable since they offer a model of how innovations become adopted in their environments. A development project (especially ICT-project) often brings new innovations to the environment where it is implemented. In these cases, Roger’s innovation decision process theory can help to understand how the innovation is adopted by its users. The innovation diffusion process describes the diffusion of an innovation as a process over time with five stages:

Figur 3: Innovation Diffusion Process

The stages are:
1. Knowledge: First knowledge of an innovation
2. Persuasion: Forming an attitude
3. Decision: Decision whether to adopt or reject the innovation
4. Implementation: The implementation of the new innovation
5. Confirmation: Confirmation of the decision

4.2 Innovations and Behavioral Change

Gourville have studied how innovations get adopted, and stresses the importance of the degree of behavior change that is required to adopt the new product. There is practically always an existing way to solve a given
problem, and when an innovation arrives with a new solution, two properties are especially important:

- What degree of behavior change is required to use this new solution compared to the existing one?
- What degree of product change is involved, i.e. how much better is the new solution?

Gourville states that the larger degree of behavior change required, the longer it will take for the innovation to be adopted. All innovations can be classified into one of four categories:

- *Easy sells* – limited product and behavior changes
- *Smash hits* – significant product changes, limited behavior changes
- *Sure failures* – limited product changes, significant behavior changes
- *Long hauls* – Significant product and behavior changes

![Figure 4: Product and behaviour change.](image-url)
4.3 Stakeholder Mapping

The definition of a stakeholder is an individual or a group who depend on a organization to fulfill their own goals and on whom, in turn, the organization depends. Stakeholder mapping identifies stakeholders’ expectations and power and helps to establish their political priorities. It involves making judgments on two questions:

- How interested is each stakeholder group to impress its expectations on the organizations strategies?
- Do they have the power to do so?

The result can be mapped in a power / interest matrix as seen below. The matrix indicates what type of relationship the organization should have with each stakeholder group. (Johnson & Scholes, 1999)

![Figure 5: Power / interest matrix.](image)
5 Systematic Literature Review

A systematic literature review was performed to gather current published research on the sustainability of projects. This chapter presents the results of the literature review, the selected method was explained in chapter 3.

5.1 Results of the Systematic Literature Review

The selected set of papers in the literature review can be described as an approximation of the current knowledge on the sustainability of projects. As stated earlier, it consists of both journal papers and organization guidelines from international organizations such as the United Nations and the World Bank. The papers offer their respective opinion of what factors affect the sustainability of projects. Together, their findings make up the current view of what project planners should focus on in order to create sustainable projects. The identified areas can be regarded as success factors that if they are satisfied increase the likelihood for a project to sustain. The literature review resulted in 18 such factors in total, and they are presented below.

5.2 Success Factors for Creating Sustainable Projects

5.2.1 Economic Viability

The first factor considers the economic viability of a given project. It is a frequent finding among the research literature that a project must achieve the economic targets it was planned for in order to sustain. One needs to distinguish between those projects that are intended to be economic self-sufficient and those that are not. In the first case, the literature suggests that the project should be able to at least recover its operating cost. Experiences of the Technology and Infrastructure for Emerging Regions group at Berkeley, University of California, indicate that recovering initial investments is desirable, but maintaining a positive cash flow is usually hard enough in ICT projects in rural areas (Surana et. al., 2008hg). Achieving
positive cash flow is crucial to the sustainability – a negative cash flow could easily terminate a project simply due to lack of cash. By maintaining a positive cash flow, aid or donor support is used for start-up costs but not for on-going operations. If the project is not intended to be self-sufficient, a different situation arises. In this case, the sustainability depends on the partners’ capacity to maintain the results. Government revenue, user fees and other income generating activities may secure such funding, and hence contribute to sustainability (SIDA, 2007).

5.2.2 Economic Resilience

The literature explicitly highlights the need for economic resilience, i.e. a buffer for unexpected costs. This implies that the project needs to plan for a robust budget so that headroom exists for unforeseen expenditure. When economic resilience is not planned for, a sudden setback can terminate the project. Economic resilience can be seen as a subset of the overall economic viability, hence the difficulties of achieving economic viability also affect this factor. Batchelor et. al. (2003) recognized while studying twelve ICT projects that recovering costs for replacement parts turned out to be very hard in a majority of the projects. Without on-going donor support, such situation may terminate a project.

5.2.3 Human Resources

In a study of ICT projects, Batchelor et. al. (2003) tested the hypothesis “the sustainability will be affected by the human capital available” and found support for it. Other scholars have found they same result, it is a common finding in the literature that the sustainability is dependent on the availability of personnel with adequate training (Mayanja, 2001; Surana et. al., 2008). Two issues are under consideration here: Firstly, there must be personnel available with suitable knowledge, or processes for supplying such knowledge, to complete all duties (technical, management etc.) in a project. Secondly, the project must ensure that personnel with this knowledge are sustained over time. In an open job market, the project stands
to risk that personnel take their new experience and knowledge and move on to other jobs.

5.2.4 Sensible Choice of Technology

In the case of technology being involved in the project, the literature suggests that the technology should be chosen with great care. “The technology used (...) should be appropriate to the economic, educational and cultural conditions of the host country,” states SIDA (2007) in its evaluation manual for development projects. While this may seem obvious, the literature indicates it has not always been the case in ICT projects. One of the main findings of an UN study 2001 of ICT in development projects was that “the priorities of many ICT projects tend to be influenced more by the interests of external organizations rather than community-based organizations” (FAO, 2001). Instead the study asked project planners to not introduce technology for its own sake, but “solely to meet the information and communication needs of the target group” (FAO, 2001). Other researchers consent in this finding, e.g. Heeks (1999) states that when stakeholders with an own agenda, such as ICT vendors, consultants or aid donors, dominate the project there is a risk they promote their own interests with an “if it works for us, it’ll work for you” mentality. Fife et. al., (2007) concludes that when selecting technology “oftentimes, simpler is better”. Overall, there is great support in the literature for choosing technology with simplicity in mind. In this situation, the principle of Occam’s razor can be applied: choose the most simple technology that satisfies the given need.

5.2.5 Maintenance & Stability of Equipment

The literature promotes using standard technical equipment, as opposed to advanced or custom-made equipment. Using proven technology that is available off-the-shelf has plenty of benefits. Firstly, there is greater chance that the technology is well tested and robust, hence lower likelihood of failure and the subsequent need of maintenance (Batchelor et. al. 2003:2). Secondly, in the case of maintenance eventually is needed, there is greater
likelihood that required tools and replacement parts are available. Thirdly, by using standard equipment, there is greater possibility that personnel are familiar with the equipment or the required knowledge is available in the community.

5.2.6 Clear Objectives
In development projects there are often many stakeholders involved. It is not certain that every stakeholder shares a common objective – certain stakeholders may very well have an own objective. While this might work out fine, the literature indicates that shared objectives that are held by the majority of stakeholders increase the likelihood of project sustainability. (Batchelor et al., 2003). Furthermore, the objective of each stakeholder should be visible and clear to all parties to enhance the possibilities for the project to sustain.

5.2.7 Clear Target Group
The literature indicates that each project should have a well-defined target group that the project is intended to provide services for (infoDev, 2007). The need of a clear target group is consequently a success factor that should be handled at the planning stage of a project. As noted above, a development project often consists of many different stakeholders. While the target group may be apparent to some of the stakeholders in a given project, it is important that the group is explicitly defined so that all stakeholders are aware of it and in consent.

5.2.8 Improvement of Existing Process
Development project is commonly intended to offer a new improved solution to a specific problem (Surana et al. 2007). There is usually an existing solution to any given task, even if it is a poor one. The literature suggests keeping this fact in mind and tie the new solution to the existing one. There are advantages to regarding the project in relation to the existing solution: If the target group already understands and supports the given
solution, variations of it will easier be accepted and require less communication and education. Furthermore, it is often unclear to outsiders why the current solution looks the way it does, which implies that large changes might fail because of unknown premises. By viewing the project as an improvement of an existing solution, “desktop-solutions” that are planned without relation to the present situation and unlikely to sustain are much prevented (Surana et. al. 2007).

5.2.9 User Relevancy

A development project must be consistent with the needs of the targeted beneficiary, partner, region or country (CIDA, 2004). In other words, it must be relevant to its indented users. This may seem obvious; it is however one of the most common findings by the researchers in the literature review. The need for user relevancy could hardly be underestimated: if the users do not consider the project useful, it is likely to fail. Fife et. al. (2008) notes that services that demonstrate their utility quickly and are considered useful will be used in the everyday life by its users, which in turn encourages further adoption. Hosman et. al. (2007) proposes that projects by “starting from the bottom-up and not the top-down helps reveal the wants and needs of the people who will ultimately determine whether any project is successful in the short- and long term”. Mayanja (2001) notes that the economics of a project is closely linked with its user relevancy and states in a report about community telecentres that once the telecentres are sustainably relevant in terms of services, they will also be sustainable financially (Mayanja, 2001).

5.2.10 Social Support

The literature indicates the need for social support for a project in order to sustain. This success factor is closely linked to user relevancy: a relevant project is more likely (but does not necessary) receive social support from a community (IFAD, 2003). The literature suggest that gaining support from grassroots organizations is much helpful when it comes to achieving buy-in
from the community citizens. Grassroots organizations refer to smaller community organizations rooted in the local area. The importance of building social support from such organizations stem from the fact that people are more likely to support a project if a well-known local part is already supporting it.

5.2.11 Local Ownership

One of the more common findings of the research in the literature review is the importance of local partner ownership. In a development project there is often a local partner organization involved. Local ownership means that the local organization has responsibility for the project and authority to manage it. The Canadian International Development Agency (CIDA) states that “local ownership of project (...) with commitment for results and methods chosen to achieve them” is a key success factor for creating sustainable projects (CIDA, 2004). Their Swedish counterpart, the Swedish International Development Cooperation Agency (SIDA) goes even further and notes that “without partner country ownership development interventions can usually not be sustained” (SIDA, 2007).

5.2.12 Institutional Support

No development activity can be undertaken in isolation. The literature indicates that by receiving support from public and private institutions, a project has greater likelihood to sustain. Institutional support can be described as key linkages to relevant authorities and organizations working in connected areas. IFAD (2004) highlights the need for institutional support and specifically cooperation with regulators in those cases when legal issues might arise. Batchlor et. al. (2003) suggest that building on existing local formal and non-formal local structures to create partnerships with both public and private institutions is a success factor for sustainable projects.
5.2.13  **Cultural Context**

In order to sustain, the literature point out that any development project must be designed with its specific cultural context in mind. Since every culture has its own norms, values and processes, what does work in one place may very well fail in another cultural context. Fife et. al. (2008) note that a project being in tune with local norms and has greater chance to sustain since it has greater chance to achieve community buy-in and be embedded into the daily life of its user.

5.2.14  **Embedding**

Embedded means deeply rooted in the surrounding. One of the findings of the literature is that projects are not likely to sustain if their users does not adopt the new processes that a project create and embed them in their daily routines. Heeks (1999) concludes this success factor: ”for long-term sustainability, the project must ’institutionalized’: embedded in the rules and norms, culture and values of its setting. This makes a project used as a matter of routine”. The embedding of a project can be seen as the result of other success factors: if a project is economically viable, highly user relevant, and so forth, it is more likely to be embedded. This success factor is hence the result of other success factor, but in itself an own determinant for the sustainability of a project.

5.2.15  **Environmental Impact**

The environmental impact of a project is always to be regarded states the literature. Despite what intention a given project has, its environmental impact must be investigated and designed for. An otherwise successful project may have to be terminated if its environmental impact is unpleasant. SIDA (2007) states that the environment is often under pressure in developing countries from “population growth and poor management of natural resources”. Hence, the environment is fragile and “partner organizations may be forced to discontinue healthy projects if it implies environmental degradation”.

28
5.2.16 **Partner Governance**

As indicated by other success factors, local partner organizations have great impact on the chances for a project to sustain. The literature explicitly points out the importance of sound governance and management of the partner organizations (SIDA, 2007). Weak or ineffective management of organizations may considerably reduce the likelihood of a project to sustain.

5.2.17 **Exit Strategy**

A development project often consists of different stages. In order to achieve greater likelihood of sustainability, the literature suggests that an exit strategy for the different stakeholders should be formulated. This exit strategy should define exit points for each stakeholder that indicates when and how each stakeholder will end its participation. A well-designed exit plan that is agreed upon by all stakeholders diminishes the risk that the project is untimely abandoned by a stakeholder, and thereby increases the likelihood of a sustainable project.

5.2.18 **Corresponding Partner Priorities**

The literature indicates that corresponding priorities among the partner organizations involved in a given project is a success factor for sustainability (CIDA, 2004). This factor stresses the importance of partners having roughly equal priorities and indicate that troubles can occur when one partner drives a project according to its own priorities, and other partner organizations merely go along but in essence have different priorities. These situations are set up to eventually fail. SIDA concludes in its evaluation manual “the priorities of partner organizations are critical to the sustainability of their results” (SIDA, 2007).
5.3 Analysis

5.3.1 Analysis of the Systematic Literature Review

In this section, the 18 success factors presented above are analyzed.

As stated earlier in this thesis, the reason for collecting the current research on project sustainability was to establish a current “state of knowledge” on the sustainability of projects. The next step is to structure this knowledge and make it accessible to the authors and other practitioners.

Being a young research area spanning over several subjects, it is not surprising to find that a “common language” among the scholars has not been established in the literature. Instead, the scholars commonly use different terminology and relate similar concepts to separate themes etc. In order to present the material in a manageable way, the authors inevitably had to group similar factors together and select one of the proposed names, while at the same time minimize the risk of losing level of detail.

While studying the literature of project sustainability, it is striking that a few factors stand out in frequency – they are recurring in close to every study. The three most frequently identified success factors are economic viability, cultural context and local ownership. Different studies use different notions but the meanings are essentially identical. These factors constitute the closest there is to a common viewpoint in the literature. Together, they form the foundation of the current understanding of determinants of sustainability in projects.

On the contrary, there are factors that are identified only by researchers in a specific study, occurring once in the whole literature study. There can be many reasons for this, e.g.:

1) They are valid for all studies, but has only been identified once
2) They are invalid for all studies
3) They are valid for the specific study but not relevant in other studies

As we are attempting to collect a comprehensive picture of the current knowledge on project sustainability, the factors that are rarely identified in the research present a challenge. If they belong to the first category above (they are valid) they should be included. On the opposite, if they belong to category two, they should be excluded. It stands clear that the authors can not deem which category these rarely found factors belong to and they consequently must be included in a collection of current knowledge that is aiming to be comprehensive. Project sustainability is a young research field and the understanding of the determinants of sustainability is yet at an early stage. Given this attribute, we argue that a collection of possible determinants of sustainability rather should be overly broad than too narrow. In other words: facing the risk of missing a necessary factor, we rather include too many.

The third category above relates to another problem: the “generalizability” of the factors: if a success factor is found to be valid in a given project, what other types of projects is it valid for? If a specific factor belongs to the third category above, it indicates that it is not generalizable to other types of studies. Since the systematic literature review included diverse kind of studies, it is likely that certain factors are relevant in various types of projects and not in others. For example, choice of technology might be crucial in a typical ICT-project but irrelevant in a project that distributes schoolbooks. As noted above, a comprehensive collection of the current knowledge on project sustainability must be broad in order to cover all aspects. On the other hand, if the research results are to be accessible, they should be as simple and compact as possible, without irrelevant information.

The systematic literature review was performed in this thesis to create a current “state of knowledge” which could be used to construct a tool for judging the ability of a project to sustain. This tool could then be applied to Ericsson’s project in Tamil Nadu, India. In order to achieve this, the result
of the systematic literature review is handled in the following way: First, the set of success factors is structured into sub-categories. The set of factors is refined by combining factors that are closely related. Second, a general model of what makes projects in developing countries sustainable is constructed based on the simplified version of the findings of the systematic literature review. The purpose of the model is to enable practitioners to employ current research results when planning and conducting projects to maximize their likelihood to sustain. It is intentionally broad to fit various types of projects, hence it can be adjusted to fit each particular application. Third, this general model is investigated and adjusted to fit ICT-projects especially to create a tool that is particularly suited for application on Ericsson’s project in Tamil Nadu, India.

5.3.2 Categorization of the Success Factors

The 18 factors found in the systematic literature review can be divided into two categories: those relating to different kinds of resources and those relating to the various stakeholders. Furthermore, three different types of resources can be identified: financial resources, technical resources and human resources. In the same way, three types of stakeholders can be found: users, partners and institutions. Using this categorization, the success factors can be structured as presented in the table below.
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<td>Technological Resources</td>
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<td>Clear Target Group</td>
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<td>Environmental Impact</td>
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Table 1: Categorization of the Success Factors
5.3.3 Refining the Framework

As a few of the factors are closely related, it is possible to refine the framework by combining closely linked factors under new umbrella terms. The first set of factors can be described as a straightforward and reasonably objective collection of the literature findings. By combining factors, the results are influenced by the authors’ judgments, but with the benefit of giving a more accessible and user-friendly framework. One can argue that by combining categories there is a risk that the framework could loose a level of detail. This risk is handled by clearly defining each factor and what it includes.

The following adjustments of the framework can be made:

*Economic resilience*, meaning that the project needs an economic buffer for unexpected costs, is closely linked to the overall *economic viability*. These factors can be combined under economic viability by employing the following definition of economic viability:

*Economic viability*: The project must at least be able to accomplish the economic targets it was set out to achieve, regardless of what those targets are, implying a need for sound financial planning and a reasonable resilience to unforeseen expenditure.

Furthermore, *clear objectives* and *corresponding partner priorities* are closely related. *Clear objectives* imply that the majority of stakeholders share a common, explicit objective. *Corresponding partner priorities* means that the project’s partners have corresponding priorities to avoid that a project is driven according to one partner’s independent agenda. By stating that the stakeholder should share a common agenda and have equal objectives for the project, both factors are included. The following definition of *corresponding partner priorities* accounts for both factors:

*Corresponding partner priorities*: The objectives and priorities of a project’s partners should be clear, visible and homogenous for all partners in a given project.
A clear target group is a requisite for creating service and processes that are relevant for the users, therefore the success factor clear target group can be combined into user relevance by using the following definition of user relevancy:

*User relevancy:* The project must conform to the needs of a clearly identified target group and be relevant to the target group both today and in the future.

*Embedding,* meaning that the project’s processes and results are embedded and utilized by its users as a matter of routine is a success factor for creating sustainable projects. This factor relates to the innovation theories presented in chapter 4. ICT-projects can represent an innovation in the setting where it is conducted. In these cases, embedding can be viewed as the last stage of Roger’s innovation decision process. The user has gained knowledge of the new processes, formed an attitude about them, taken the decision to adopt them, implemented them in her life and is now in the last stage of the process: confirmation. Roger’s state that if a user the stage of confirmation can evolve into four ideas about an innovation: continued adoption, later adoption, discontinuance, or continued rejection. Here, the embedding of a project corresponds to the continued adoption. However, unlike the other success factors, embedding cannot be planned for, it is rather a result of other factors. For instance, a project with high user relevancy and strong social support is more likely to be embedded, but the project owners cannot affect it – it is solely the choice of the users. Hence, we argue that in a framework targeting project planners the factor embedding could be excluded for the sake of reducing complexity.

Given the categorization of success factors presented in section 5.4, and the adjustments made by this section, the success factors can be mapped out to construct a framework as illustrated in figure 6 below. We name this tool the *project sustainability framework,* and construct it with the intention to help in planning, conducting and evaluating projects to maximize their chances to sustain.
Figure 6: The Project Sustainability Framework
5.3.4 Tailoring the Framework for ICT-projects

As noted above, the Project Sustainability Framework is broad in order to fit various types of projects, and it is likely that various factors of the framework is irrelevant for certain types of projects. This section investigates what adjustments can be made to tailor the framework for ICT projects especially.

ICT-projects in general differ from other types of projects in the sense that technology is likely to have a larger focus. Looking closer, it seems that a few factors of the project sustainability framework is particularly important in ICT-project. New information and communication technologies often require new knowledge for handling and maintenance. It can therefore be argued that the human resources and sustained availability of staff is highly important. Furthermore, the success factors under the category technological resources are likely to be highly important. The first one, sensible choice of technology, denotes that the simplest technology that satisfies the given need should be chosen for the project. Naturally, this is particularly important in ICT-projects. The second factor, maintenance & stability of equipment promote the use of standard consumer-grade technical equipment as far as possible, as opposed to custom-made equipment. As ICT-projects are in general dependent on the functionality of some technical equipment, this factor is also especially relevant.

Optimization of existing system promotes that projects are designed as improvements of existing processes, rather than being deployed “from scratch”. New technologies emerge frequently as ICT develop faster than most other industries. When conducting projects with new innovations involved, it becomes particularly important to relate the solutions provided by the new technology to the existing solution. This relates to Gourville’s theory of the adoption of innovations. Gourville states that the larger change of behavior that is required to use a new innovation, the longer it will take for the innovation to be adopted. As previously described, Gourville defines four types of innovations:
The factor *optimization of existing system* in essence promotes that projects utilize incremental innovations with small required behavior change – those that belong to Gourville’s top row, *easy sells* and *smash hits*. It is hard enough to make development projects sustain – bringing technology that can be characterized as *long hauls* only further decrease the chances of sustainability. The important part here is the behavioral change required: we argue that the new project very well can implement radical innovations, as long as the required behavioral change is low.

For the remaining factors of the project sustainability framework it can be said that none can be disregarded – as discussed in the analysis of the literature review, one cannot know exactly which factors matter in what types of project beforehand. Consequently, they must all be regarded to ensure greatest possibility of sustainability.
6  Case study: The Gandhigram Project

The Gandhigram project is a health project in southern India, intended to spread healthcare to rural areas by utilizing telemedicine. This chapter first introduces the concept of telemedicine then the project is presented in detail. Later, the results from applying the project sustainability framework on the Gandhigram project are presented and analyzed.

6.1  Introduction to Telemedicine

Telemedicine is the application of medicine over distance by transferring medical information via any type of communication technology. It includes a wide range of applications: in its simplest form it could be a telephone call to the local healthcare consultancy, or in its most extreme form, a doctor conducting surgery on a patient in a remote location with the help of live video and robot technology.

With to this definition, telemedicine has been used in some form since the invention of radio communication, although the name was introduced much later. During the last decade telemedicine has received great attention, much owing to the rapid development of ICT. In a 2008 report, the industry analyst firm Gartner stated “Telemedicine applications offer the promise of using technology to make radical changes in the way healthcare is delivered” (Gartner, 2008).

Advanced applications such as tele-surgery are under research at universities, but more conventional applications such as telephone consultations are already used in different parts of the world. The chart below illustrates a few applications and their stage of development.

![Figure 8: Telemedicine applications: Stages of development](image)
Today, the global leaders of telemedicine are developed countries with large proportions of their population in remote areas such as Australia, Canada and Norway (Solberg, 2008). However, developing countries are increasingly interested as telemedicine may provide new and cost-effective ways to distribute healthcare, especially to remote areas. Telemedicine pilot projects have recently been launched in Kenya, Uganda, Senegal and Mozambique. The Chinese government has initiated a large-scale project aiming to link the population in rural areas to healthcare providers in the cities. In India, numerous pilot projects have been conducted, and they are internationally being viewed as largely successful (Solberg, 2008).

As often experienced with new technologies, telemedicine applications can face skepticism from doctors and patients. Little research has been done in this area, but a few individual medical institutions that have employed telemedicine applications and monitored their patients’ satisfaction levels have found them to be high (Solberg, 2008).

**A definition of telemedicine**

Giving the large variety of applications, it is of little surprise that a clear definition of telemedicine is lacking. In the 2007 paper “What Is Telemedicine? A Collection of 104 Peer-Reviewed Perspectives and Theoretical Underpinnings” (Sood et. al, 2007) found a large spectrum of definitions of telemedicine. Sood et. al. collected them and proposed the following one which highlights telemedicine as a subset of the wider notion telehealth:

Telemedicine being a subset of telehealth, uses communications networks for delivery of healthcare services and medical education from one geographical location to another, primarily to address challenges like uneven distribution and shortage of infrastructural and human resources. (Sood et. al., 2007)
Telemedicine in India: The different levels of telemedicine

Since telemedicine has a broad definition, a further classification is helpful. In India, the Ministry of Health & Family Welfare uses the following tiered hierarchical structure to describe the various levels of telemedicine application in India (Ministry of Health & Family Welfare, 2008).

- **LEVEL-M**: Mobile telemedicine units (e.g. buses, vans) covering a few villages in connection to the nearest Primary Health Center (PHC) or Community Health Center (CHC)
- **LEVEL-1**: A Primary Health Center (PHC) or Community Health Center (CHC) which are using telemedicine and connecting to a District Hospital
- **LEVEL-2**: A District Hospital using telemedicine and connecting to a State Hospital or National Super Specialty Hospital
- **LEVEL-3**: State hospitals or National Super Specialty Hospitals connecting to each other

These definitions are helpful to understand the various levels where telemedicine is used. The studied project is an example of a Level-M telemedicine project.

6.2 Apollo Hospitals

The Gandhigram project is conducted by Ericsson AB and Apollo Hospitals Group. Apollo Hospitals is an Indian private healthcare provider. It is the largest healthcare group in Asia with 10,000 beds across 43 hospitals. The name Apollo Hospitals is well known among the Indian public and the brand was named "super brand of India” 2003 in a voting by marketing and advertising professionals (Chennai Online, 2003). In 1999, Apollo Hospitals
was the first to set up a rural telemedicine centre in India; it has since been a major player in the development of telemedicine in the country.

6.3 Spreading Healthcare in Rural India: The Gandhigram Project

The Gandhigram Project, initiated by Ericsson and Apollo Hospitals, is a feasibility study to determine if a “Hospital-on-Wheels” (HoW) equipped with mobile telecommunication technology could be used by a specialty hospital to increase its outreach and serve the rural population. The main driver of the project is Apollo Hospitals, Ericsson provide the technological knowledge, and Hand-in-Hand, a Non-Governmental Organization (NGO) with activities in Tamil Nadu, provide local knowledge of the rural villages. The project is a pilot study to determine the feasibility of using telemedicine to quantify the health status of a pre-selected rural community. The selected population consists of adults in a group of villages in the Dindigul district of Tamil Nadu, southern India. The HoW is equipped with an X-Ray machine, Electrocardiogram (ECG), Echocardiogram (ECHO), ultrasound and video conferencing equipment. The HoW visits a predefined set of villages where members of the community are screened onboard the HoW, and medical specialists at a hospital can be virtually present via mobile technology. The mobile communication technology used is a standard EDGE-enabled GSM-network. EDGE (Enhanced Data rates for GSM Evolution) is a mobile

![The Hospital on Wheels used in the project.](image1.jpg)

42
communication technology that improves the data transfer speeds of a traditional GSM-network. EDGE is sometimes described as “2.75G” as it enables transfer speeds close to those of the newer technology 3G.

The primary objectives of the Gandhigram project, as presented by Apollo Hospitals are:

- To elicit the health status in a representative population 1000 adults living in villages in Gandhigram district of Tamil Nadu, southern India.
- To determine the feasibility of using mobile telemedicine (EDGE technology) for transmitting X-Ray images, Ultrasound images, ECG, ECHO cardiograms and for being able to do a reasonable clinical examination including Tele-auscultation, monitoring blood pressure, pulse rate and temperature, blood Pressure and pulse recording.

6.4 Results of the Application of the Project Sustainability Framework

Below follows the results of the application of the project sustainability framework on the Gandhigram project. The Gandhigram project is a bit
special in the sense that it has a predefined goal of examining 1000 patients during the pilot study and has no intention of continuing thereafter. Therefore, the project is evaluated as if it was intended to be a permanent, sustainable project instead, disregarding that the number of patients is limited to 1000 today.

Two main sources of information were used when applying the framework. The authors visited the project in Tamil Nadu and traveled with the HoW to the rural areas which allowed for own observations. Interviews were performed with key personnel of the project to gain insight of the project’s details.

Here follows the results from the application of the different aspects of the framework. In the following section, they are analyzed further.

6.4.1 Financial Resources

Economic Viability

The first thing to identify is whether the project is supposed to be financially self-sufficient or not. As stated above, the Gandhigram project is intended to run in a limited period of time and is not supposed to be financially self-sufficient; Apollo Hospitals and Ericsson fully funds the pilot project at this stage. The question is rather if a similar future project could be financially self-sufficient. According to Dr Ganapathy, head of Apollo Telemedicine Foundation, going into telemedicine is not recommended for a company that wishes to make a quick profit (Ganapathy, 2008). The utilized type of Level-M telemedicine is complicated since it involves a HoW (Hospital on Wheels) which requires large investments and targets villages where the average income is low and citizens likely will have a hard time paying the fee that Apollo Hospitals normally charge for a consultation. So far, no study has been made of how a consultation in the HoW could be priced. Although, it is clear that the alternative cost for the villagers’ visiting specialist in the nearest hospital is much higher (Ravindra, 2008). The alternative cost consists of a patient fee, the loss of one or more daily wages plus the cost for transportation and accommodation.
An alternative to user fee funding is to acquire funding from external organizations, such as the government, a NGO, or other donors. Dr Ganapathy believes there is good opportunity for external funding but it is cumbersome since major donors such as the World Bank wants to see documented results in numbers and figures from previous large projects to ensure that the donation is effective. There are no such results available today, but Dr Ganapathy hopes to be able to conduct and document larger studies further on and regard the Gandhigram project as a step in that process (Ganapathy, 2008).

6.4.2 Technological Resources

Sensible Choice of Technology

The HoW used in the Gandhigram project is not new. It has been used before in similar projects but with a satellite connection as transfer medium instead of EDGE. The usage of the satellite connection was discontinued since it was too cumbersome to set up and not very easy to use (Ganapathy, 2008). The EDGE technology presents a compelling alternative since it is a mature technology that is already available. The question with EDGE is instead whether it is fast enough in a real world situation to transfer the required data to conduct tele-consultations, i.e. medical consultations with the patient located in the HoW and the doctor located in a remote hospital. The requirements in terms of

Picture 3: Interior from the HoW, the X-ray machine.
transfer speed depend on the type of examination. One desired feature is to be able to transmit real-time video between the How and the hospital since this allows the doctor to interact with the patient. Real-time video with the quality of a typical videoconference is possible with a bandwidth of 128-384 kbps (VIDA, 2008). During the preliminary tests, the uplink transfer speed was about 80 kbps. This speed could be increased a little bit in ideal settings but it still wouldn’t reach 128 kbps for the uplink. Another problem is the latency, which can hinder a smooth real-time video transfer. (Thokala, 2008) A preliminary test that was conducted on the HoW consisted of uploading two X-ray pictures, an electrocardiogram, ultrasound video recordings and a pulse graph to Apollo Hospital’s server. This took around eight minutes to complete. The time it takes to upload the data is shorter than the time it takes to conduct an examination of a patient. A digital camera is used to digitalize the X-ray image before they are sent, the rest of the information is in digital form from the beginning. The data is transferred to a computer via various mediums such as CD, serial cable and USB cable. The computer is connected to a cell phone, which acts as a modem and transfers the data to the server.

**Maintenance and Stability of Equipment**

The device used for transmission of data is a standard GSM mobile cell phone and during the pilot test various mobile phones from different brands were tested. The phone was in turn connected to a consumer-grade laptop.

By adjusting the allocation of timeslots in the network (see explanation box) the mobile operators in the area (e.g. Vodafone) can optimize their network for voice or data traffic. Since the usage of data is limited, the networks are usually optimized for maximum voice traffic. This means that extra

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**EDGE – Enhanced Data Rates for GSM Evolution**

EDGE is an evolution of the standard GSM mobile network. To enable a mobile network to handle multiple connections simultaneously, each frequency is divided into “timeslots” (short periods of time). The timeslots are shared between voice and data traffic. If more timeslots are allocated to voice, it enables more people to speak simultaneously. If more timeslots are allocated to data, it enables higher transfer speeds.
timeslots needs to be allocated to data in the network for the data connection to reach the desired maximum speed. This requires staff on the bus to contact the mobile operator and to ask them to allocate the needed timeslots before the consultations start. “In the case of a large scale project, Apollo could make an agreement with an operator in which the operator guarantees the needed time slots in the current area”, says Loganathan Thokala, technician with Ericsson India. Another necessity is that the operator is able to provide a public IP-address for the cell phone. This is needed for the data transfers to work. Currently, approximately half of the available mobile operators in the area offer this (Thokala, 2008).

6.4.3 Human resources

Availability of Staff
Knowledgeable staff is a requisite for the possibility to conducting tele-consultations. The sustainability of staff is therefore a direct marker on the overall sustainability of the project. The staff needed to conduct tele-consultations varies due to the particular medical application, but includes paramedic nurses, doctors, bus drivers and technicians. Dr Ganapathy acknowledges that there is always a risk of loosing your trained staff to other companies willing to pay more for their expertise, especially since Apollo Hospitals can’t offer the salaries that foreign companies can. On the other hand, Apollo Hospitals is one of the few institutions in the world that has formal education in telemedicine together with a university, to ensure that they have a supply of staff for the future. The sustainability and scalability of the staff is a solvable problem as long as there are money to pay for salaries and education. “With the money, I will be able to get the remaining people needed, technology people, and put them in position. There are enough motivated people” (Ganaphaty, 2008).

6.4.4 Institutions

Institutional Support
Healthcare, in general, is subject to many regulations so legal issues could be a possibility for level-m telemedicine. Being a relatively new phenomenon, it is unclear where telemedicine belongs in regulatory terms. However, there have not been any legal issues this far:

We had a national telemedicine taskforce meeting one year ago (...) about 80% of India’s providers of telemedicine were there in that meeting (…) I actually put the number of teleconsultations (performed by the attendants) together and we came to a number of about 375’000 teleconsultations (…) I asked everybody in public, not one person sitting in that room said they had a medical legal problem (…) so please don’t run away from telemedicine because you think that one day in the future there may be a legal issue!
Dr. Ganapathy, 2008

From a political viewpoint, health is a state subject in India, so telemedicine is somewhat dependent on the enthusiasm of the state’s chief minister. On a governmental level, there is however great support for telemedicine initiatives. The Ministry of Health & Family Welfare of the Government of India constituted a national task force on telemedicine in September 2005 with the purpose to foster Indian telemedicine. One of the purposes of the task force is to form a standard for Indian telemedicine. The Ministry has sent out a draft to the states of India with suggested architecture and guidelines for a national telemedicine network. They have also released funds to create new or expand existing initiatives (Ministry of Health & Family Welfare, 2008).

**Environmental Impact**
To some extent, the Gandhigram project reduces the use of paper due to the fact that the telemedicine applications use electronic documents instead. The Hospital-on-Wheels used in the Gandhigram project is a diesel bus, which implies emissions of carbon dioxide as an immediate effect of the project. Naturally, no results could be collected for long term environmental effects, but this subject is discussed in the analysis.
6.4.5 Partners

Local Ownership
Apollo Hospitals is the main owner of this project. Ericsson is contributing with technical knowledge and guaranteeing that the communication technology is working. Hand-in-Hand is contributing with local knowledge of the villages in the area but have no larger responsibilities.

Sound Partner Governance
Apollo Hospitals came into being in 1983, starting its first hospital in Chennai. According to Dr Ganapathy, the telemedicine department of Apollo Hospitals has a lot to thank the management of Apollo Hospitals for, stating they have “been able to see twenty years into the future” as they have allocated funds to telemedicine projects that have close to none revenue potential in the short term.

Corresponding Partner Priorities
According to the project specification, the Gandhigram project has two stated objectives:

- To elicit the health status in a representative population of one thousand adults living in villages in the Gandhigram district of Tamil Nadu, southern India.

- To determine the feasibility of using mobile telemedicine (EDGE technology) for transmitting X-Ray images, Ultrasound images, ECG, ECHO cardiograms and for being able to do a reasonable clinical examination including Tele-auscultation, monitoring blood pressure, pulse rate and temperature, blood Pressure and pulse recording.

In addition to these stated objectives, Apollo Hospitals wishes to create a “proof of concept” that can be used to apply for further funding for future telemedicine projects. Apollo Hospitals started its telemedicine initiative as a corporate social responsibility initiative, but in the long run it will be
needed to give a minor profit (Ganapathy, 2008). Ericsson is instead interested in finding success stories of new ways to use mobile communications. It is a way for Ericsson to show their own customers, the operators, new ways of employing their technology. Ericsson is also interested in increasing its focus on services.

**Exit strategy**

Ericsson and Apollo Hospitals have no intention of leaving the project, and have no outspoken exit strategy (Sukumaran, 2008).

**Users**

**User Relevancy**

Why is the Gandhigram project relevant to the villagers? With 72% of the population living in rural areas, but 80% of the doctors living in urban areas, the relevancy of a service that enables remote access to healthcare is clear (Business Monitor, 2008). When it comes to secondary and tertiary care, 90% of the facilities are in the towns and cities far away from the rural India, making the need for new alternatives even greater (Ministry of Health & Family Welfare, 2008). As the outreach of the primary health centers is inadequate (Sood, 2002), the level-m telemedicine can be used to close the largest gaps in the current infrastructure.

**Cultural Context**

Local presence is helpful in order to be in touch with the local cultural context. One observation the authors made during their visit in India is that a lot of the decision making regarding the Gandhigram project is done in Chennai, which is relatively close to the site where the pilot study is conducted, and by people with good knowledge of the area. Another affecting factor is that one of the stakeholders in the project is Hand in Hand, a NGO with local presence in Tamil Nadu and knowledge of the villagers (Ravindra, 2008).

**Social Support**
Social support is to a large extent dependant on the testimonials of the treated patients to their family and friends in the community. In previous similar pilot projects conducted by Apollo Hospitals show that the patients visiting the HoW during the pilot phase are positive to the project and appreciate the healthcare given to them. One potential issue that relates to the social support is that Apollo is seen as an elite caregiver for the rich (Ganapathy, 2008). This could make the potential patients a bit reluctant, thinking that Apollo Hospitals is not a hospital for them.

**Optimization of existing system**

The Gandhigram project is in essence spreading the existing healthcare processes to new areas. The HoW is intended to be perform medical examinations in a similar manner as is done at hospitals.

6.5 **Analysis**

*In this section, the results from applying the framework on the Gandhigram project are analyzed.*

6.5.1 **Analysis of Results**

**Economic Viability**

The economic viability of the Gandhigram project is far from clear. The authors think that this is one of the largest issues to solve if the Gandhigram project in the future should become sustainable. Today, Apollo Hospitals’ patients are mostly foreigners and citizens from the highest income segment. A visit to a regular Apollo Hospital is priced at INR 400 for the first consultation; medicals and any visits to specialists thereafter are charged separately. To put the prices into context, the average daily wage for a non-agriculture male worker in rural India is INR 60-120. The same number for agricultural male workers is 40-90 INR (Labour bureau, 2005). A study in 2004 showed that people in rural India spend a higher proportion of their income on healthcare than their urban counterparts (Royal Philips Electronics, 2005). A large percentage of the cost goes to paying interest on
loans for healthcare. The remainder of the cost is travel and lost of daily wage. The high alternative cost indicate that the people in the rural areas could be prepared to pay a premium for teleconsultations since it saves them a lot of money not having to travel. The question is how big this premium is since the inhabitants have relatively low income. Given this property, we think it is unlikely that patient fees will pay the full cost of the teleconsultations.

What is clear however, is the need of healthcare in the rural areas of India. Since the buses reach a whole new market, the increased customer base might lead to a lower cost per patient (Ganapathy, 2008). For example, the Aravind eye hospitals, also situated in Tamil Nadu, has managed to increase its effectiveness by greatly increasing volume and reducing costs. As a result, the cost of a typical eye surgery is today less than half the cost for a similar surgery by a private practitioner (India Together, 2008).

Economic viability is, as one of the papers on project sustainability stated, a factor that usually can be helped by large “relevancy”: if the project is seen as relevant by patients, politicians and other stakeholders, it is more likely to get the funding needed. There should be good chances of receiving future external funding: in the Indian government’s 11th five-year-plan (for 2007-2012) INR 2000 million was allocated to telemedicine initiatives. Most of this funding will be channeled to public-private partnerships (Solberg, 2008).

To conclude, the economic viability of the Gandhigram project is largely unclear, but there are possibilities of being economically viable, financed by a mixture of external funding and user fees. The business needs to be investigated thoroughly.

**Sensible Choice of Technology**

The EDGE technology is fast enough for the transfer of the data from the examinations but will probably hinder the use of real-time video, which is a
setback compared to other technologies such as 3G networks and satellite communication. In perfect conditions or if the video was compressed hard it could be possible to transmit live video, but it is doubtful that it would be practically feasible in a field situation. Additionally, while live video is sent, it uses all the available bandwidth, meaning that other files would have to wait. For all applications that do not require live video, EDGE is sufficiently fast since the time required to send the data is shorter than the time it takes to conduct an examination; the bottleneck will therefore not be the transfer speed.

The biggest advantage of the EDGE technology is that it is easy to use, already available today, and Ericsson has extensive knowledge of the technology: they both build and maintain the EDGE networks around the world. Furthermore, the project could easily upgrade to 3G-technology, the next generation of mobile communication technology, when it is available in India. The lack of live video capability can be compensated with skilled staff in the bus that can conduct the right examinations and be the doctor’s eyes on site, and recorded video could still be used. The process of collecting the data from the different machines could definitely be done in a more efficient way, but it would require purchasing of new equipment. That improvement could be done regardless of transfer technology and has nothing to do explicitly with the choice of EDGE as transferring technology.

To conclude, the authors think that EDGE is a good example of when the purpose and not the technology itself has been the centre of attention. EDGE presents a “good enough” solution with minimal extra investments, which fulfills the recommendation in the literature of sensible choice of technology.

**Maintenance & Stability of Equipment**

All of the equipment used for the transmission of data is standard consumer grade equipment and it has been available in the area for many years. This means that replacement units could likely be arranged fast and relatively inexpensive in the case of a failure. This is important since the reliability of
the mobility connection is a crucial part of the system. The equipment used to conduct the medical examinations is far from consumer grade but Apollo Hospitals, being the largest hospital group in Asia, has extensive knowledge of both handling and maintaining this kind of equipment. Therefore, the handling of the equipment should not be a problem. However, the stability of the mobile connection could be a potential problem. To guarantee fast connection speeds, an agreement with an operator should be signed, to guaranteeing that they adjust their network to provide a satisfactory number of timeslots.

**Availability of Staff**
India is a relatively well-educated country. Judging from the interviews, it is clear that Apollo Hospitals are very confident that they will have the staff needed. “We are in a unique position where we are a developing country, but not undeveloped, and most importantly we have not only hardware and software, but we also have an abundant amount of what I like to call brainware” (Ganapathy, 2008). There are reasons to believe they are right – Apollo Hospitals have a very strong brand and own facilities to educate their people. For Ericsson’s part, the situation is similar. It is reasonable to think that human resources are one of the smaller factors affecting sustainability in this particular project.

**Institutional Support**
Gandhigram is not explicitly supported by any institutions, however, it is likely in a good situation for being supported by political institutions. Telemedicine is favored by the Indian government, which has created a taskforce and earmarked money to use in telemedicine initiatives. Political institutions is consequently likely to be in tune with the project’s objectives. Looking at religious institutions, India is according to its constitution a secular republic where all the citizens are free to worship or propagate any religion or faith (The Constitution of India, 1949). The two largest religions are Hinduism (approximately 80%) and Islam (approximately 13%) (Census of India, 2001). No religious institutions explicitly support nor oppose the
project and the authors cannot find any subject that could be controversial to religious institutions.

**Environmental Impact**
Telemedicine, in general, is environmental friendly in the sense that it enables people to seek medical expertise while minimizing the need for traveling (American Consumer Institute, 2008). The reduced use of papers is known as “e-materialization” and is a general property for telemedicine applications (American Consumer Institute, 2008). In the Gandhigram project, the carbon footprint of the HoW (a diesel bus) is not encouraging. However, if the alternative would be hundreds of patients traveling on their own to a hospital, it would likely have a worse effect on the environment. Under the condition that the population would otherwise have traveled themselves to a hospital, it is likely that the Gandhigram project have a long-term positive effect on the environment. In all other aspects, the environmental effects of conducting the medical treatment in the HoW instead of in a hospital are largely the same.

**Local Partner Ownership**
Apollo Hospitals is without doubt the main owner of the project, it is in essence a medical project containing technical components. The aspect *local partner ownership* of the project sustainability framework is fully handled.

**Sound Partner Governance**
The nature of this question makes it hard to get a good answer. By studying the public decisions made by the management, we can state that Apollo Hospitals have been largely successful during their 25-years as a company. The governance seems reasonable and the company is well thought off by the public. This might however just give a small picture since a lot of a company’s actions are hidden to outsiders. By asking employees and members of the organization, we only found similar indications. However, this has implications since the respondents might answer in a biased way, and asking how the company is run might be seen as offending by the partner organizations management. To conclude, there are however good
reasons to believe the governance of Apollo Hospitals can be characterized as sound.

**Corresponding Partner Priorities**
The Gandhigram project has two stated objectives. However, we can identify additionally two long-term objectives:

Short-term:
- Elicit the health status of a village population.
- Determine the feasibility of EDGE in telemedicine.
- 

Long-term:
- Apollo Hospitals: To create a foundation for funding of future larger projects.
- Ericsson: Show new uses of mobile communication.

Of these, the short-term objectives are explicitly stated, while the long-terms could be read between the lines. This indicates that Ericsson and Apollo Hospital’s priorities differ quite a bit. According to the framework, this is a property that can overthrow a project. Today, neither Apollo nor Ericsson has any plans for a future termination of the partnership. However, we believe this exemplifies one of the major differences of a business partnership that the framework in its current form does not account for. This is discussed further in section 6.7.

**Exit strategy**
Since Ericsson has no outspoken exit strategy, an initial thought could be that this is troublesome for the sustainability of the project. This might on the other hand not be so surprising, since the actual project has a predefined goal of 1000 patients and therefore is relatively short. Since we want to evaluate the project as if it was intended to be a permanent and sustainable project we have to look at the it in a different way. The representatives of both Apollo Hospitals and Ericsson seemed happy with the partnership and gave us the impression that
they were interested in a long-term partnership. Ericsson gives Apollo Hospitals access to world-class knowledge about ICT. Another factor is that they both are present in many countries, which is very helpful if Apollo wishes to expand the concept to other countries. Since exit strategy is not explicitly taken care of in the Gandhigram project it is given a low score in the evaluation of the project later in this chapter. However, since the Gandhigram project seems to function well without an exit strategy, this factor is discussed further in chapter 6.7.

**Cultural Context**

The authors are convinced that Apollo Hospitals, together with Hand in hand, has sufficient knowledge about the local customs and culture in the area where they are doing the pilot study. During our visit, it was obvious that both Ericsson & Apollo Hospitals cared a lot about the integrity of the patients. One example of this is that they said it was sensitive how we approached the patients and could be a bit controversial if we started to ask the patients questions about their perception of the project. Instead we had to ask for the patient’s opinions by talking to social workers and the staff onboard the HoW. We see this as an example of awareness of the local norms and customs.

**Social Support**

The support for the project in its current form is without doubt strong, since it enables the villagers to get specialist consultations free of charge. Free health check-ups from a well-known hospital to people who lack healthcare will always be an easy product to “sell”. Even if a patient fee is introduced further on, we are optimistic about the social support as long as villagers regard the fee as reasonable. The issues about social support mentioned earlier are of solvable nature. Apollo might be seen as an elite hospital for the rich, but this can also be a positive labeling since the brand reassures the patient that they can trust the quality of the care they receive. This is something that is even more important in the case of telemedicine since people are used to see the doctor in person and might be a bit skeptical about telemedicine. The biggest issue as we see it is that the social support is fragile. If an accident or a miss treatment of any kind would occur, this could create a large future skepticism from the patients. For example, a

**Optimization of existing system**

57
The Gandhigram project is an example of a typical project that improves an existing system: the doctor’s are great; one only needs to improve rural access to them. As noted earlier, similar projects have been conducted earlier with different communication technologies, such as satellite communication. The Gandhigram project is a continuation of these projects, and cannot be characterized as a “desktop-solution”, it is consequently not likely to fail due to this factor.

6.5.2 Summary of the Analysis

The interviews and with the visit to the villages of the Gandhigram project provided great insight to the project’s possibilities and challenges. The project has in various degrees covered the different aspects of the project sustainability framework. It should be noted that the Gandhigram project was planned without knowledge of the authors’ work on project sustainability. The chart below visualizes to what extent the project has satisfied the different aspects of the project sustainability framework.

To what extent has the Gandhigram project satisfied the following aspects of the project sustainability framework?
As seen by the chart, the Gandhigram project handles large parts of framework very well. However, three factors have been poorly satisfied: economic viability, exit strategy and corresponding partner priorities. The economic viability scores low due to the unfinished business model; it is not clear and has not been studied how a sustainable version of the Gandhigram project would be financed. Therefore, we will investigate this area further in the next section, 6.6. Corresponding partner priorities and exit strategy scores low due to the fact that the two main partners, Ericsson and Apollo Hospitals, ultimately have quite different objectives and priorities, and no exit strategy has been discussed. This is discussed further in section 6.7.

6.5.3 The Business Case for Telemedicine

The economic viability of the Gandhigram Project was largely unclear, both in terms of expenses and income. We will examine this by performing a
bottom-up analysis of the costs involved in a Level-M telemedicine project and subsequently discuss the possible income streams.

Estimation of costs for a mobile telemedicine vehicle
The Ministry of Health & Family Welfare of the Indian Government have prepared a draft budget for the costs involved in providing level-m telemedicine in India. The numbers are estimates, and in case of uncertainty the estimated maximum value per unit is taken. The costs are in regards to a mobile van equipped with the following medical equipment: digital electrocardiogram (ECG), glucometer, pulse & blood pressure unit, digital microscope, digital camera and A3 film scanner. As comparison, this is a smaller vehicle than the bus used in the Gandhigram project, although equipped with similar equipment except the X-Ray and ECHO units which the Gandhigram project utilized.

### Fixed Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (INR)</th>
<th>Cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile van with integrated bed and other provisions</td>
<td>INR 2 500 000</td>
<td>USD 52 323</td>
</tr>
<tr>
<td>Medical Equipment</td>
<td>INR 3 600 000</td>
<td>USD 75 344</td>
</tr>
<tr>
<td>Hardware / Software (including PC server, etc.)</td>
<td>INR 35 000</td>
<td>USD 733</td>
</tr>
<tr>
<td>Telemedicine Consulting Center (TCC ) software</td>
<td>INR 200 000</td>
<td>USD 4 186</td>
</tr>
<tr>
<td>Video conferencing kit</td>
<td>INR 250 000</td>
<td>USD 5 232</td>
</tr>
<tr>
<td>Terrestrial IP (512 kbps) scalable</td>
<td>INR 10 000</td>
<td>USD 209</td>
</tr>
<tr>
<td>Van equipment integration</td>
<td>INR 100 000</td>
<td>USD 2 093</td>
</tr>
<tr>
<td>Training costs</td>
<td>INR 50 000</td>
<td>USD 1 046</td>
</tr>
<tr>
<td>Installation &amp; commissioning</td>
<td>INR 100 000</td>
<td>USD 2 093</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>INR 7 160 000</td>
<td>USD 149 852</td>
</tr>
</tbody>
</table>

Table 2: Fixed Costs

### Annual Recurring Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (INR)</th>
<th>Cost (USD)</th>
</tr>
</thead>
</table>

60
Site Administrator + technician + van operator | INR 446 000 | USD 9 334
---|---|---
Medical staff allowance | INR 156 000 | USD 3 265
Annual maintenance charges hardware/software | INR 630 000 | USD 13 185
Annual update / support charges for software | INR 40 000 | USD 837
Annual bandwidth cost per year | INR 50 000 | USD 1 046
Total | INR 1 322 000 | USD 27 668

Table 3: Annual Recurring Costs

In total, the costs for a mobile telemedicine vehicle as defined above is estimated to approximately USD 150,000 in fixed investment costs and USD 28,000 in annual recurring costs. It should be noted that these costs are estimations for India, with the Indian price level in mind. In regards to the medical staff allowance, Apollo Hospitals offer slightly higher allowance to their medical staff compared to public hospitals, implying a slightly higher cost-estimate for Apollo Hospitals than the above estimation suggest. However, the allowance for medical staff account for only 12% of the total recurring costs.

As can be seen by the pie charts below, medical equipment makes up half the total sum (51%) of the fixed costs and the mobile vehicle accounts for approximately a third (35%). In the case of recurring costs, the largest posts are maintenance of hardware and software (47%), and allowance for the non-medical staff such as site administrators, technician and the vehicle operator (34%).

**Distribution of Costs: Estimated Fixed Cost for a Mobile Telemedicine Vehicle**

- Van with integrated bed: 35%
- Medical Equipment: 51%
- Other: 14%
Figure 10: Fixed Costs

Distribution of costs: Estimated Annual Recurring Costs for a Mobile Telemedicine Vehicle

Since there is large demand of healthcare in the villages, we can assume full capacity utilization of the mobile vehicle. The total number of patients that the can be served is then limited by the time an average examination takes. The required for an typical examination varies a lot but 2 visits per hour is an low estimate. Given an eight hour work day, of which one hour is required for traveling and setup, and 240 work days per year, the total number of patients that can be served yearly can be calculated as:

\[ \text{visits/year} = 2 \text{ visits/hour} \times 7 \text{ hours/day} \times 240 \text{ days/year} = 3360 \text{ visits/year} \]

If the annual recurring costs of USD 27,668 is distributed over the 3,360 patients, this amounts to a estimated cost of USD 8.2 per patient and year (INR 394):

\[ \frac{\text{USD 27,668}}{3360 \text{ visits/year}} = \text{USD 8.2 (INR 394) per visit and year} \]
In other words, the break-even point for the variable costs are 8.2 USD per patient and year. By adding the fixed investment costs, (USD 149 852), calculated with linear depreciation over 10 years, the calculation looks like:

\[
\text{USD } 27668 + \frac{\text{USD } 149852}{10 \text{ years}} = \text{USD 12,7 (INR 607) per visit and year}
\]

With the initial fixed investment costs added, the total costs adds up to USD 12.7 per patient and year.

These numbers are highly interesting as they indicate that the cost for conduction telemedicine via mobile vehicles are in a reasonable range. For comparison, Apollo Hospitals today charges INR 400 for a standard first consultation at one of their hospitals. This is however seen as a quite large sum and as noted earlier, Apollo Hospitals are mainly visited by foreigners and affluent citizens. The average income in rural areas is slightly lower compared to urban areas, although the alternative cost of receiving healthcare is higher. Considering that the costs are in a reasonable range and the Indian Government has earmarked USD 2 billion for telemedicine initiatives, we believe the possibilities for finding a suitable mixture of financing is encouraging. To conclude this section, it is likely that a sustainable solution for the financial viability can be found.

**6.5.4 Revision of the Framework: Exit Strategy & Corresponding Partner Priorities**

As previously noted in the analysis of the Gandhigram project, Ericsson and Apollo Hospitals have different reasons and priorities for the project. According to the framework, this could be a problem for the sustainability of the project.
The Gandhigram project is not the first project Ericsson and Apollo Hospitals have cooperated in. In 2007, a project named Gramjyoti that demonstrated the possibilities of a 3G network was conducted. Ericsson was the main driver and built the network, and Apollo Hospitals provided telemedicine applications. Since then, a long-term partnership has been agreed on between the two companies. The Gandhigram project is one step in that partnership. After visiting the project, the impression was that corporations had different objectives but it was not likely to put the project at stake, which created doubts about the validity of the factor corresponding partner priorities.

The project sustainability framework defines corresponding partner priorities in chapter 5.5 as “the objectives and priorities of a project’s partners should be clear, visible and homogenous for all partners in a given project”. The framework was built on the findings of the literature review. However, the studies in the literature review were in large studies of projects conducted by NGOs and other non-profit organizations. In the Gandhigram project, we are dealing with profit-driven corporations. The Gandhigram project had two short-term objectives and in addition to those we identified long-term “background” objectives. But the ultimate objective of both Ericsson and Apollo Hospitals, as with most corporation, is to maximize profit or shareholder value. We believe Ericsson and Apollo Hospital is rational in their priorities regarding the project: although they have different objectives of the project, they depend on each other for fulfilling their respective objectives. This indicates that in a partnership between corporations, a better determinant than corresponding partner priorities might be sustainable partner interdependence. As long as the partners depend on each other for fulfilling their objectives, there is lower need for the objectives to correspond with each other.

The differences between corporations and non-profit-driven project partners can be seen as a background variable that influences the framework. We believe it has implications for at least one other factor: exit strategy. In the Gandhigram project, no exit strategy was formed, which is understandable.
given the short scope of the project. If the project were longer and for instance designed so that one part would leave half-ways, the need of a strategy of when and how that exit would take place would have been larger. However, as is common between corporations, Ericsson and Apollo Hospitals have agreed on a long-term partnership, of which the Gandhigram project is a product. When the author’s visited the project, Apollo Hospitals stated that they had no intention of ending the partnership with Ericsson since they gave them access to expertise that they lack themselves (Ganapathy, 2008). Ericsson responded that there was no need for exit strategy as there was a mutually beneficial partnership between Ericsson and Apollo Hospitals (Sukumaran, 2008). This brings us back to the factor of sustainable partner interdependence suggested above. This relates to the aspect of an exit strategy in that sense that there is no need for one as long as the partners are sustainable dependent on each other to achieve the wanted positive outcomes.

6.6 The Gandhigram Project: Conclusions

The economics of the Gandhigram project was the largest question mark the author’s identified while studying the project. After braking down the costs and the possible income streams, the Gandhigram project is believed to have very good chances of sustain in a future long-term version as a means to provide healthcare to rural India. Furthermore, the application of the project sustainable framework highlighted the differences between projects conducted by NGOs and by corporations, and adjustments of the framework were suggested based on this finding.
7 Conclusions

7.1 Research Findings

In the introduction of this thesis, three research questions were formulated for this thesis:

- What factors affect the sustainability of Information and Communications Technology (ICT) projects in developing countries?
- What does current research say about sustainability of projects?
- How can the current state of research be concluded in a framework that allows to employ the research results in actual projects?

The first two questions was answered primarily by the systematic literature review. This thesis collected thoroughly the current research of what makes projects in developing countries sustainable. The finding was that the ability of such projects to sustain is affected to a set of 14 factors relating to the resources and stakeholders involved in a project. This finding built up the project sustainability framework, which allowed the use of research results in actual projects. By applying the framework to the Gandhigram project, we found that the economic viability was unclear, but after examining this property further concluded project has great chances of being sustainable.

7.2 Contributions

This thesis has gathered the current research on sustainability of projects, compared it, and established a current state of knowledge of the subject. We believe this is useful for both scholars and practitioners, as it reflect where the research stand today. This knowledge were used to create the project sustainability framework which is valuable for practitioners when planning, conducting and evaluating projects to maximize their likelihood to sustain. For Ericsson, the thesis has examined and judged the abilities for the
Gandhigram project to sustain in a long-term perspective. Additionally, the company can utilize the project sustainability framework in its future projects. These contributions are also concluded in a shorter folder to be used in the field when evaluating projects.

### 7.3 Further Research

The area of sustainability of projects is relatively new, hence, it is natural that the understanding of what makes projects sustain is yet early. There are many openings for further research. One way of building on this thesis would be to further validate and evolve the project sustainability framework. A suitable research subject, e.g. for a future master thesis, would be to apply the project sustainability framework on current projects and validate the model, or apply it on a larger number of historical projects where data is available.

### 7.4 Validity and Reliability

To examine the validity and reliability of this thesis, the authors have followed the three-step question process presented below:

1) Reliability – to what extent has the design of the study affected the results?
2) Internal validity – is there a decent foundation for the conclusions? Has the subject that was intended to be studied actually been studied?
3) External validity – to what extent can the conclusions be generalized?

This process gives the analysis and conclusions from this thesis a better foundation. The purpose is to give the analysis a stronger foundation and to give the reader an idea of how applicable the thesis’ results are. (Paulsson, 1999)
The choice of conducting a systematic literature review for the gathering of data is likely the choice that influenced the results the most. The systematic literature review was chosen as we regard it the best way of collecting the full picture; we wanted to create a comprehensive picture of what research had found out about the sustainability of projects. By choosing other methods, e.g. interviews with prominent persons, there was a risk that the gathered inputs would be biased by personal experiences and therefore would become hard to collect the full view.

The design of the literature review affects the results, as it is impossible to read all the literature on the subject. The selection of keywords and sources followed common recommendations, and we consider the design appropriate for its purpose. Likewise many social sciences, it is hard to determine the causal relationships in project sustainability. The termination of a project is often the result of many factors interacting with each others, which makes it is troublesome for the internal validity of the study. To address this challenge, the study of determinants for sustainable projects was intentionally designed as broad. In other words, we choose to sacrifice precision to ensure validity.

### 7.5 Objectivity

The main issue where the objectivity can be compromised is the relation between the authors and Ericsson and the authors and the university. As the thesis was based on an assignment from Ericsson, the authors will be financially compensated from Ericsson for the study, which is not uncommon for a master thesis. However, this could influence the authors to trying to provide results that are pleasing the company (Paulsson 1999). On the contrary, when the thesis is judged by the university, the grades are only passed or not passed, and Ericsson is committed to pay regardless of result. It is however important for the reader to know this fact.
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Appendix A

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